

Origins of Semiosis



Approaches to Semiotics

116

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Origins of Semiosis

Sign Evolution in Nature and Culture

Edited by

Winfried Nöth

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*For Walter A. Koch
From his students, colleagues, and friends*

Contents

Winfried Nöth

| | |
|--------------------|---|
| Introduction | 1 |
|--------------------|---|

| | |
|---|-----------|
| Part I: Evolution and biosemiosis..... | 13 |
|---|-----------|

Myrdene Anderson

| | |
|---|----|
| Breathing life into signs: Ways and means of semiotic transition and transformation | 15 |
|---|----|

Udo L. Figge

| | |
|--|----|
| Semiotic principles and systems: Biological foundations of semiotics | 25 |
|--|----|

Winfried Nöth

| | |
|---|----|
| Opposition at the roots of semiosis | 37 |
|---|----|

Signe and Holger Preuschoft

| | |
|--|----|
| Primate nonverbal communication: Our communicative heritage..... | 61 |
|--|----|

| | |
|--|------------|
| Part II: Anthroposemiotic sociogenesis and cultural semiogenesis... | 101 |
|--|------------|

Peter Meyer

| | |
|---|-----|
| The problem of certainty in human communication: An evolutionary view..... | 103 |
|---|-----|

Peter Grzybek

| | |
|---|-----|
| The culture of nature: The semiotic dimension of microcosm, mesocosm, and macrocosm | 121 |
|---|-----|

Gordon W. Hewes

| | |
|---|-----|
| Evolution of human semiosis and the reading of animal tracks..... | 139 |
|---|-----|

Paul Leyhausen and Jörg Pfleiderer

| | |
|--|-----|
| Analysis of a human releasing mechanism..... | 151 |
|--|-----|

Susan Vogel

Early social games reconsidered: Culture at play 205

Colwyn Trevarthen

Infant semiosis 219

Part III: Glottogenesis: Phylongeny, ontogeny, and actogeny..... 253

Robin Allott

Language and the origin of semiosis 255

Bernhard B. Bichakjian

Language evolution: A Darwinian process 269

Vitaly Shevoroshkin

Deep reconstruction of languages and semantics..... 293

Roland Harweg

Material time and formal time: Genetically and metagenetically..... 309

Yoshihiko Ikegami

The agent and the sentient: A dissymmetry in
linguistic and cultural encoding 325

Helmut Schnelle

Language and brain 339

Interchapter..... 365

Roland Posner

Structure as idyll: The genesis of meaning in nature 367

Part IV: Eikonogenesis and graphogenesis..... 383

Emmanuel Anati

Constants in 40,000 years of art..... 385

Paul Bouissac

Deixis vs. modeling in the phylogeny of artistic behavior 405

Martin Krampen

Children's drawings: Ontogenetic aspects and phylogenetic roots 419

Richard W. Janney and Horst Arndt

Can a picture tell a thousand words? Interpreting sequential
vs. holistic graphic messages..... 439

Götz Wienold

Writing, inscription, and text..... 455

Part V: Appendix 479

List of contributors..... 481

Index of names 487

Index of subjects 497

Introduction

Winfried Nöth

The life of signs in the minds of their users is an infinite process. As Peirce has taught us, every act of semiosis creates new signs in a dialogic process of interpretation, taking place not only between different interpreters, but also within the interpreter's own semiotic self.¹ Such processes of semiosis can only be "interrupted", but never really be "ended" (Peirce, CP 5.284). Can there be an origin to this never ending process, or does semiosis begin with the evolution of our cosmic universe (cf. Anderson 1989)?

The question of our origins and its semiotic representation was a topic once hotly debated by our orthodox forefathers, who asked:² "Should Adam be depicted with or without a navel?" Drawn with a navel, Adam could not have been the first of humankind. Drawn without a navel, he would not have been a complete man. In modern semiotics, Adam's navel has been the so-called semiotic threshold, the dividing line between the semiotic and the nonsemiotic universe (cf. Nöth 1990: 81-83). Some modern semioticians, guided by the paradigm of language, have pleaded for drawing Adam without a navel by setting up the semiotic threshold at a level as high as the human mind. The authors of the present volume vote for Adam with a navel and are resolved to pursue their search for the origins of semiosis further back in the evolution of life.

Semiogenesis, the evolution and development of semiosis since its origins, is a broad field of research. According to Koch (1982b: 18), it "covers the interrelated geneses of such phenomena as animal communication, computer systems, oral language, written language, theater, film, gestural systems, philosophy or religion as languages, the language of the drums and flags, pheromones or logic as sign systems, DNA as genetic 'code', painting etc. . . ., an array of apparently heterogeneous and yet somehow isomorphic systems." There can be no search for *one* origin of a field as broad as this one. Instead, a plurality of origins and a plurality of evolutionary and developmental paths from primitive semiosis to the most complex and highly evolved forms of present-day semiosis will have to be pursued.

1. **Semiosis and semiotics**

Semiosis, according to Peirce, is the “intelligent, or triadic action” of a sign (CP 5.472). The triad consists of the sign, as a signifying stimulus, the object represented by the sign, and the “significate outcome” of the sign in the mind of its interpreter (CP 5.473). Semiosis is thus the process in which a sign has a cognitive effect on its interpreter (cf. CP 5.484). Semiotics is then “the doctrine of the essential nature and fundamental varieties of possible semiosis” (CP 5.488).

The scope of semiotics has been defined in a narrower and in a broader sense (cf. Nöth 1990: 81-83). The narrower definition has been advocated in the tradition of Saussure’s semiolinguistics, or better linguo-semiotics, which considers language as the sole key to the world of semiosis. Only language gives structure to our perceptions of the world. Since “nothing is distinct before the appearance of language”, the nonsemiotic world is “a vague, uncharted nebula” (Saussure 1916: 111-112). Such and other anthropocentric views of semiosis have obstructed the view of semioticians for an evolutionary perspective of semiosis.

The evolution of semiosis can only be studied in the framework of a semiotics transcending the limitations of anthroposemiotics. Such a perspective is inherent in Peirce’s view of the “entire universe” being “perfused with signs, if not composed exclusively of signs” (CP 5.488, fn.). One of the broadest variants of this pansemiotic view of semiosis is the one advocated by Koch (1986a: 54), who defines semiotics as a metadiscipline which “enables us to discover traces of semiosis . . . in everything: from original atoms through extravagant thoughts”. In contrast to this partly pansemiotic view of the universe, which discovers traces of semiosis as early as the origins of cosmos, Peirce’s semiotic view of the universe requires the presence of an interpreting mind as an essential criterion of the beginning of semiosis, since “nothing is a sign, unless it is interpreted as a sign” (CP 2.308). On the other hand, semiotic interpretation, “intelligence”, and mind, according to Peirce, are not categories restricted to *Homo loquens*. Semiosis begins with the evolution of life.

2. **Biosemosis and the semiotic threshold**

In the evolution of our universe, biogenesis evolves parallel to semiogenesis. As Sebeok (1986: 15) points out, cosmic evolution before biogenesis was mere informational evolution. With biogenesis, by

contrast, we reach the semiotic threshold at which signs begin to emerge. According to Sebeok (1986: 15),

semiosis is what distinguishes all that is animate from the lifeless. Before semiosis, there was information. According to the standard (big bang) theory of cosmic genesis, the universe began totally devoid of information, but it quickly evolved out of that initial state as a measure of the multiform. The essence of information is change, the prerequisite of semiosis is life.

To establish the semiotic threshold at an evolutionary point as low as the origin of life has not remained undisputed by semioticians (cf. 1.). Much of the debate about the distinction between signs and non-signs, however, has been of a terminological nature, concentrating on such questions as whether signals or indices are “already” or “not yet” signs or whether signs must be intentional and necessarily intraspecific (cf., e.g., Schult 1992). Semioticity, however, is a matter of degree, and there is a hierarchy of criteria by which lower forms of semiosis can be distinguished from higher ones (cf. Nöth 1990: 169). A hierarchy of criteria to determine several lower thresholds in the biological evolution of semiosis has been set up by Bentele (1984: 138ff.). Further thresholds leading to ever higher levels of semiosis in human communication have been distinguished by Posner (1992). Koch (1986a: 54), by contrast, emphasizes not the dividing line, but the continuity between the non-semiotic and the semiotic world, when he proposes his Evolutionary Cultural Semiotics as a project to “embark upon the reconstruction of an objective, ultimately indivisible, flow of reality, of which the evolution of matter, of life, of consciousness, of culture, and of signs are but special points of emergence”.

Nevertheless, in spite of all evolutionary continuity, the emergence of signs from the world of mere physical processes remains to be determined. Peirce draws this dividing line between dyadic and triadic interactions (see also Nesher 1990: 2, 4). His semiotic threshold is the one which leads from dyads of interactions between physical causes and effects to triadic interactions in which an organism interprets (forms an *interpretant* of) its environment, the signifying stimulus (*representamen*), relative to a goal (the *object*) which is distinct from the environmental stimulus.

Not every stimulus-response interaction involves semiosis. Consider the event of a stone dropping by chance (stimulus) on an organism that reacts with death to the ensuing injury. This interaction exemplifies dyadic, and not triadic, interaction. Semiosis begins with responses that

are goal-directed (Short 1986: 114), but requires neither consciousness nor intentionality (unless intentionality is defined as the pursuing of a goal). Metabolic “reactions” of an organism to environmental stimuli are goal-directed actions. Organisms select, and hence evaluate, environmental energy or matter *for the purpose*³ of their own survival, while at the same time rejecting other environmental stimuli as unsuitable. This process exemplifies semiotic thirdness at the lowest threshold of semiosis. Peirce even saw the action of a “mind” and psychology involved at this level. Furthermore he postulated that the agent need not be an individual but can be a whole species in its process of evolution:

Mind has its universal mode of action, namely by final causation. The microscopist looks to see whether the motions of a little creature show any purpose. If so, there is mind there. Passing from the little to the large, natural selection is the theory of how forms come to be adaptive, that is, to be governed by a *quasi* purpose. It suggests a machinery of efficiency to bring about the end . . . But the being governed by a purpose or other final cause is the very essence of the psychical phenomenon, in general. (Peirce CP 1.269)

3. Framework for the evolution of semiosis

A holistic evolutionary world model to determine the emergence of semiosis within a continuum of discrete stages, beginning with cosmogenesis and continuing to ever higher systems of sign use, has been developed by W.A. Koch in his writings since 1973.⁴ According to this model, the world of semiosis emerges from the origins of cosmos in the following successive stages (Koch 1986a: 14-20; 1986b: 12; 1987a: 2; 1991c: 217):

- (1) *Cosmogenesis* or physicogenesis (Koch 1987b: 67): beginning 15 billion years ago with the physical expansion of the universe at the moment of the big bang (Koch 1986c: 93-114).
- (2) *Galactogenesis*, galactic evolution: 12.5 billion years.
- (3) *Geogenesis*, the origin of earth: 4.5 billion years.
- (4) *Biogenesis*, the appearance of life on earth (from bacteria to protozoa): from 4 to 1.7 billion years ago.
- (5) *Sociogenesis*, the origins of social organization: 500 million years ago.
- (6) *Semiogenesis* [in the narrower sense], the origins of human culture: beginning with *Homo habilis* 2 million years ago.

- (7) *Glottogenesis*, origins of language: 50,000 years ago.
- (8) *Eikonogenesis*, origins of pictorial representation: 30,000 years ago.
- (9) *Graphogenesis*, the invention of writing: 5,000 years ago.
- (10) *Typographogenesis*, the invention of printing: 1400 A.D.
- (11) *Mediogenesis*, the diffusion of television: 1950 A.D.

In contrast to the terminology adopted in this introduction and elsewhere in this volume, semigenesis as the sixth evolutionary level of Koch's model does not refer to the semiotic threshold at which semiosis begins, but to a higher prototype of semiosis, the one in which artefacts begin to be used as sign vehicles in anthroposemiotics (Koch 1986c: 126). The earliest beginnings of semiosis are at the lower levels of biogenesis and sociogenesis where they emerge in the form of biosemiosis, zoosemiosis, and sociosemiosis. The genetically preceding levels, from cosmo- to geogenesis, provide the material basis of semiosis, but the sphere of the material world also evinces structural isomorphies with the world of semiosis. These isomorphies in the evolution from matter to semiosis are indicators of evolutionary continuity and coherence and justify the assumption of an indivisible evolutionary whole with traces of semiosis since the very origin of cosmos (cf. Koch 1987b: 54, 71).

Besides its chronological dimension, evolution has a variety of aspectual facets for whose study Koch (esp. 1992) provides an elaborate conceptual framework. In contrast to scholars who emphasize the differences between *evolution* and individual *development*, Koch emphasizes the similarities between *genesis* in *phylogeny*, the evolution of the species, and *genesis* in *ontogeny*, the process of individual maturation. Following Ernst Haeckel's biogenetic rule, Koch (1992: 172, 182) formulates a general principle of *echogenesis* according to which phylogenetic processes tend to be recapitulated ("echoed") in the processes of ontogeneses and other geneses.

Genesis, evolution at large, is furthermore distinguished from *meta-genesis*, the discovery and re-experiencing of genesis in human consciousness, e.g., in religious *mythogenesis*, philosophical theories of *cosmogenesis*, or *epistemogenesis*, the "epistemic reconstruction of the entire objective-subjective world" (cf. Koch 1986a: 10, 17; 1991a). The relation between both is typically one of chronological reversal: metagenesis tends to mirror genesis by ascribing historical primacy to phenomena which evolved later in the course of evolutionary history. For example, whereas *Homo sapiens* comes last in genetic evolution, the human I is imagined to be first in mythogenesis and epistemogenesis.

Besides ontogenesis, Koch (1990: 23-33; 1992: 181-186) distinguishes several other variants of developmental evolution, including *actogenesis*, the process of production and reception of signs in actual semiosis, and *eugenesis*, the processes of regressive simplification as well as progressive complexification of semiotic systems in their historical development. The latter mode of genesis is related to two more general evolutionary principles, *anagenesis*, the complexification of matter, and *catagenesis*, the decomplexification of matter.

4. Preview

Koch's holistic model provides a useful framework for the contributions to the present volume. *Origins of Semiosis* considers six evolutionary levels, biogenesis (Part I), anthroposemiotic, sociogenesis, and cultural semiogenesis (Part II), glottogenesis (Part III), eikonogenesis, and graphogenesis (Part IV), but there are also excursus on cosmogenesis (Nöth) and typographogenesis (Wienold).

Part I covers general aspects of the theory of evolution and focuses on the level of biogenesis (cf. Koch 1982a, 1984, 1985, 1986b, 1992) including evolutionary aspects of zoosemiotics. In contrast to the present introduction, which seeks to *differentiate* between various evolutionary levels, Myrdene Anderson opens the volume with a paper on the ways and means of *transition* between the stages of evolution. Udo L. Figge, exploring the interaction of the organism with its biosemiotic Umwelt, reveals the evolutionary primacy of receptive in contrast to productive semiosis and concludes that the latter has only developed as an epiphenomenon of nonsemiotic processes. Winfried Nöth investigates the role of opposition in biosemiosis and at other evolutionary levels from cosmogenesis to glottogenesis. Signe and Holger Preuschoft examine the differences between the communicative potential of the four major channels of nonverbal communication in primate semiosis with reference to the evolutionary paths that lead to anthroposemiosis.

Part II deals with anthroposemiotic sociogenesis and cultural semiogenesis (cf. Koch 1982a, b, 1983, 1984, 1986a, 1986c, 1987a, b; Koch, ed. 1982, 1989a, b, c, d, 1990a). The sociobiologist Peter Meyer opens with a paper on the survival value of certainty in species specific communication and on the function of emotional semiosis in the phylogeny of human communication. The literary semiotician Peter Grzybek follows with an investigation of the anthroposemiotic sphere of mesocosm and its mythological, cognitive, and epistemogenetic place

between microcosm and macrocosm. The potential of visual indexical semiosis in hominid and early human reading of animal tracks is the topic of the paper by the anthropologist Gordon W. Hewes. The following ethological contribution by Paul Leyhausen and Jörg Pfleiderer presents the empirical results of an investigation into the gestural and facial features which constitute the male intimidation display as a human innate releasing schema. Both phylogenetic and ontogenetic perspectives are pursued by Susan Vogel in her investigation of the sociosemiotic and cultural functions of play in mother-child interaction. The final paper on infant semiosis is by the child psychologist and psychobiologist Colwyn Trevarthen gives a comprehensive semiotic account of the nature and stages of protosymbolic communication from the first days of semiotic ontogeny until the emergence of speech.

Part III deals with glottogenesis in its broadest sense (cf. Koch 1970, 1974b, 1991b; Koch, ed. 1990b), covering language phylogeny and ontogeny, attempts at linguistic reconstruction of prehistorical languages, and neurological actogenesis. Robin Allott introduces the broader semiotic framework of his motor theory of language origins which states that human language has evolved from earlier neurological programs for the control of body movements and that speech production programs have become cross-modally connected in the human brain with those earlier programs of nonverbal behavior. Bernhard Bichakjian interprets language evolution as a Darwinian process of *eugenesis* (Koch 1992: 184), which has favored the historical selection of ever more advantageous linguistic features as these develop in early language acquisition (paedomorphosis). The Russian linguist Vitaly Shevoroshkin dares to pursue the historical reconstruction of language not only as far as Nostratic, the assumed proto-language of the Indo-European, Afro-Asiatic, Uralo-Dravidian, and Altaic languages, but even further back via Austric-Australian, Sino-Caucasian, Niger-Nilotic, and Southern-African Khoisan to a Proto-World language (see also Koch 1991b: 35-36) spoken some 90,000 years ago. Roland Harweg investigates the genesis of language referring to time, demonstrates that event-related "material" time references are primary as opposed to clock- or calendar-related "formal" time references, which have evolved from primitive reifications of the solar and lunar motions, and relates these findings to Koch's thesis of metagenesis as the chronological reversal of genesis. Yoshihiko Ikegami explores the primacy of the agent (human source) in relation to the role of the sentient (human goal) in syntactic structure, relates this observation to the bodily basis for semiosis in action and

sensation, and reveals cultural differences in the encoding of these categories in the form of narrative personae. The last contribution to part III, Helmut Schnelle's paper on "Language and Brain", is concerned with the neurological actogenesis (Koch 1990: 29, 1992: 183) of language. With his insights into the neurobiological, neuroanatomical, and neuro-logical foundations of language and cognition, Schnelle also provides a frame of reference for other papers of this volume dealing with neurosemiotic topics (e.g., Bouissac, Meyer).

Part IV deals with phylogenetic and ontogenetic aspects of eikogenesis and graphogenesis (cf. Koch 1981, 1982a, 1983, 1984, 1985, 1986a, b, c, 1989, 1993a, b; Koch, ed. 1982, 1989a, b, c, d, 1990b). In an interchapter, Roland Posner presents a contribution on "Structure as Idyll" which constitutes a link between the chapters on natural and cultural genesis: inspired by Koch's structuralist visions of homologies between nature and culture, Posner wants to give an iconopoetic illustration of the principle of meaning attribution, the tendency of humans to attribute meaning, under certain conditions, even to the phenomena of nature. In his exemplification of this principle, Posner invites the reader to explore his or her semantic reactions at the perception of a sequence of scenes from nature, which appear first in black and white and then in color.

Part IV opens with the paper by the paleo-ethnologist Emmanuel Anati on constants in 40,000 years of art which develops seventeen theses on the basic patterns and archetypes of rock art from twenty major sites around the world. Paul Bouissac evolves the thesis that there are two evolutionary roots of spatial and aesthetic semiosis, an older deictic (indexical) root, which humans share with other vertebrates, and a more recent nondeictic root, which only humans evince in representational or modeling activities. Both phylogenetic and ontogenetic aspects of eikono- and graphogenesis are the topic of Martin Krampen's paper dealing with the development of pictorial and graphemic representation in children as compared with nonhuman primates. Aspects of the origins of writing in pictorial representations are discussed in Richard W. Janney and Horst Arndt's investigation of the semiotic potential of writing in comparison to pictorial representation. The final contribution by Götz Wienold explores text semiotic functions of the ancient text type of inscription and places it in the context of the evolution of the alphabet from its earliest beginnings to 20th century typography.

The all-comprehensive scope set by the topic of *Origins of Semiosis* necessarily encompasses a great thematic diversity. The disciplinary horizon of the contributors to this volume is also highly diverse: it

extends from anthropology to zoology and from linguistics to visual aesthetics. Unity in this diversity may be provided by the transdisciplinary framework of semiotics which guides the authors' explorations in the evolution of semiosis, even though the framework of this volume is by no means one of a unifying school of specific semiotic theory. All of the contributors to *Origins of Semiosis* have previously participated in one or several of Walter A. Koch's inspiring conferences in Evolutionary Cultural Semiotics (e.g., Koch, ed. 1989a, b, c, d, 1990a, b, c) and have known him as a colleague, friend, "indefatigable teacher, writer, editor, organizer, visionary, and seminal figure in semiotics", a "rock in the stream" of semiosis, as Myrdene Anderson (1990: 137) has so aptly described him. The diversity offered by the perspectives of *Origins of Semiosis* find an additional unity in the authors' dedication of this volume to Walter A. Koch.⁵

Notes

1. For references to Peirce's theory of semiosis as an unlimited process, see Nöth (1990: 43).
2. For details see Kirchner (1903: 18-19).
3. From the perspective of a biologist, Thorpe (1978: 36-76) defines the origins of life as the appearance of purposiveness.
4. For Koch's writings in evolutionary and developmental semiotics, see Koch (1973a, 1974b, 1981, 1982a, b, 1984, 1985, 1986a, b, c, 1987a, b, 1989, 1990, 1991a, b, c, 1992, 1993a, b).
The evolution of European semiotics since the 1960s from its roots in structural linguistics to ever expanding horizons is mirrored in the development of Koch's own writings. Beginning with diachronic structural research at the level of the phoneme (Koch 1970 [first ed. 1963]), his research program progressively expanded to higher levels of linguistic analysis, via the morpheme to the texteme (Koch 1969, 1971a, 1973, 1974a). With his studies in linguistic and semiotic poetics, Koch (1966, 1981, 1983, 1984) transcended the limits of the language system. The framework of language itself is transcended in Koch's (1971, 1973a, 1974b) influential studies in general and applied semiotics. The next step of this expansive development, the one to evolutionary semiotics (see above), is both a step beyond semiotics in its synchronic and anthropocentric tradition and a step leading back to the origins of Koch's own research in diachronic linguistics, the field linking up with the prehistory of modern semiotics in historical linguistics.
5. The editor is greatly indebted to Susan Vogel for invaluable editorial assistance from the point of view of the semiotically competent native

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PART I

Evolution and biosemiosis

Breathing life into signs: Ways and means of semiotic transition and transformation

Myrdene Anderson

1. Sleight of sign

Taking off from the assumption that in Indo-European languages we habitually tend to “thingify” signs (even life), I aim to dynamicize things, pushing and pulling them into open-ended temporal, processual, even if unmannered, flows. Indeed, what follows reveals an on-going tug-of-war between the comfort of digital categories and the disconcerting resolution via interpolated analogue processes. Even the distinction of digital and analogue dissolves into dichotomies or continuities, depending on one’s perspective and one’s purpose.

The perspective and the purpose here build on the metaphor of “breathing”. Breathing reveals diphasic, complementary processes of “in” and “out”. Yet there are tangible moments of “both” and “neither” – at least more tangible than those conditions in the flipping of an electric light switch. Breathing also suggests a living process, something shared in the circadian and metabolic rhythms of all known and all imagined life forms. Life forms have inspired a discourse speculating on evolutionary origins and on developmental births and deaths, and that discourse of evolution and development will be tapped as well.

To address the origin(s) of semiosis entails suspending – which is tantamount to suppressing – all awareness of our limited knowledge of the perhaps unknowable. We must suspend as well the shortcomings and flaws in our evident knowledge of the presumed knowable, that knowable sitting still long enough to be amenable to our habits of understanding. In the spirit of provisionality of constructions, I specify “origins” as well as “origin” to underline the possibility, even likelihood, of multiple sources, multiple perspectives, or just muddled ones. The important distinction between knowledge and understanding also merits serious but separate treatment.

Any of this knowledge *and* knowing, and their metonymic complements of lacking knowledge *and* unknowing *and* unknowability, if not suppressed would otherwise soberly encumber our exercise. In fact, were we unwilling to make this congenial gesture, our interrogation of

origin(s) would be rendered ridiculous, wrong-headed, futile, and further, even pathologic.

It must be admitted, however, that to suppress either knowledge *or* awareness of lack of knowledge *or* provisionality of knowability, also entails costs on the debit side of the ledger – albeit a forever open-ended and dedicatedly *unbalanced* ledger. Do we, in pinpointing “origins” of semiosis, guarantee enlightenment as to the contemporary shape or habits of semiosis? Not necessarily, I argue. Will contemporary processes of semiosis and of our semiotic inquiries enlighten their origins? Not necessarily, again, but contemporary habits of inquiry provide the watershed for our constructions, reconstructions, and deconstructions. Are we able truly to conceive of the origin(s) of time, of space, of matter/energy, of information, that is to say, of semiosis? Not unless our linguistic ability (indeed, proclivity) – to make sentences of statements in response to sentences of inquiry – can convince us that we comfortably conceive of the doubly unmarked (but not therefore marked) “before before” or “beyond beyond”. In our relativistic (including linguistic and cultural) universe, no longer can we conjure up a “god’s-eye view”.

All this notwithstanding, however, semioticians do explore such paths of knowing and unknowing as a matter of course, in pursuit of the sign and of signing. To tackle the origin(s) of the sign – whether that be consonant with the origin of semiosis or/and the origin of communication – therefore appears a noble enterprise, particularly when Walter A. Koch has laid so much of the groundwork, for example, in two of his books of 1986, *Philosophie der Philologie und Semiotik – Literatur und Welt: Versuche zur Interdisziplinarität der Philologie*, and *Evolutionary Cultural Semiotics: Essays on the Foundation and Institutionalization of Integrated Cultural Studies*. What I will do as a footnote, or a headnote, is to expand on a simple sketch of how systems breathe. Their breathing *is* semiosis, and it commences with the hic-cough signaling a discontinuity in a developmental or an evolutionary stream of signs. Following that emergence or origin, there may follow other “sighs” and startles, of various shapes and prognoses (in developmental trajectories), and of uneasy tentative post-hoc patterns (in evolutionary trajectories).

2. Development and evolution

In pursuit of semiosis itself, one looks for emergence, submergence, diversification, convergence, subversion, collapse, extinction, yes – but

one is also alert for the overdetermined and underdetermined seams in this fabric. In addition, one calls into question those very seams that appear to partition the units of ordinary analysis, although the seams (boundaries between coordinate categories and edges between non-coordinate ones) are the active sites for semiosis (Anderson 1989a, b, c; Anderson et al. 1984).

Here I will content myself with two genres of emergence, or self-organization, termed development and evolution (Dyson 1985; Karger 1986; Salthe 1993; Salthe and Anderson 1989; Anderson 1990a, b). Development and evolution apply to all semiotic processes, not just the biological ones associated with these terms. Hence, biological development and biological evolution constitute ordinary examples of these generic processes of self-organization.

In biology, development progressively actualizes organisms (tokens) in their ontogenies, and evolution erratically precipitates forms (types), such as species, in their phylogenies. Ontogenies and phylogenies mutually construct each other in a kinky, semiotic flow. Biological entities also realize themselves in a different score when viewed energetically (ingestion maintaining organismic growth and “development” in a larger spatial field of ecology) or informatically (copulation contributing to differential replication and species continuity or discontinuity, perhaps radical evolutionary discontinuity, in a temporal field of genealogy).

The terminology of biology provides handholds, sometimes slippery ones, for the apprehension of the dynamics of other open systems. Biological origins cycle through developmental births (inceptions for finite, relatively closed loops or stageal spirals) and through evolutionary speciation (threaded discontinuities in utterly open emergent processes). In other fields, the deployment of the terms “development” and “evolution” has been less consistent and often not disambiguated at all, the terms used interchangeably or only one of them selected for all dynamical processes involving continuity and change. In the corporate world, “research and development” maps relatively well onto “evolution and development”. “Economic development” is viewed deterministically, that is, in predictable and indeed developmental stages, although many of the dynamics are not accessible to any apriori assumptions. Marx’s evolution was decidedly developmental, in that historical and social time had a shape and direction. Historians tend to find developmental “rises and falls” in epochs, although occasionally it is posited that the person makes history (evolutionarily) rather than history making the person (developmentally). We can follow the gyrations of development and

evolution in the unfoldings of tragedy (suspenseful) and comedy (surprising).

A major feature of developmental beginnings and ends is their relative predictability. Development signals itself through stages, and these stages can be gingerly anticipated, albeit fostering suspense in the observer. Evolution in contrast fosters surprise. Evolution has no shape, except that which can be imposed after the fact. Indeed, after the fact evolution will appear developmental, even though we cannot predict its shape into the future.

One reason that past evolution appears developmental has to do with our habits of speech. As languaging creatures, humans (including scientists) tell stories, and our stories are temporal, linear, with beginnings, middles, and ends. We have difficulty portraying in speech simultaneity or contingency. All the possibilities inherent in every instant of an evolutionary process (and to a much lesser extent, every instant of developmental processes too), remain vague if not utterly opaque. All we have in our reconstructions are stories of the temporal flow of events. We are seldom confident as to the mix of “chance and necessity” in the events we do uncover.

Anthropologists concern themselves with the origins of any number of sign processes. One category of origin would be the evolutionary emergence of a string of biologically ancestral species within the realms of animals, vertebrates, mammals, primates, and humans, each through accidents of punctuated equilibria. But the narrative of the prehistory of these forms will often smack of development – from small to large, from shorter-lived to longer-lived, from presumably simpler to presumably more complex in form and/or in social organization. Whenever so-called evolution has a shape, as indeed it had for Darwin and later for Teilhard de Chardin, the process resembles the tamer development than the wild evolution.

In every instance, however, the temporal and spatial scale of the figured phenomenon and of the observer – including the focus, perspective, and agenda of the observer – all *participate* in the mode of self-organization. Further, the motivation of the semiotician will never reduce to mere classification. Little will be gained, and much may be sacrificed, if we ponder processes with the intent of attaching a label. In fact, virtually all processes may be explored through both lenses, as both developmental and evolutionary.

3. Transition and transformation

Both development and evolution describe irreversible change, whether gradual (but *not* consequently slow), continuous transitions of degree, or punctuated (but *not* consequently rapid), discrete, transformations of kind. When organismic change is transition-like, or perceived to the observer as gradual, we call it “growth”, over against transformation-like organismic stages, called “development”. Each of these falls into the genre of metadevelopment as “growth and development”. Although growth appears gradual, it occurs in spurts linked to the rest of development. The overall developmental process generates individual tokens of things, and is slightly deterministic in that it manifests temporally-sequenced stages, capped by equifinality. That equifinality in an organismic trope is “death” (Anderson 1991; Biddick 1993).

The developmental stages – of an organism or of a dynasty or of a scientific paradigm – are often placed in a syntagmatic narrative having a beginning, middle, and end. What comes *before* the beginning, in terms of an origin, is often off the discursive map. In fact, what comes before the beginning, is not the sigh of development but the hiccough of evolution. Evolution precipitates new twists, new genres, surprises that could not have been anticipated.

When formal change is transition-like, we are still able to find the continuous threads of change, expressed as statistical modifications of degree rather than of kind. Transition-like change in a *token* may conveniently be understood as developmental. When formal change in a *token* is transformation-like, a modification of kind within the token, we similarly recognize developmental stages. But when formal change in a *type* (or in a token at a bifurcation point) is transformation-like, we confront the evolutionary abduction of a newly created kind and/or process. Basically, the evolutionary process generating the phylogeny of kinds of things is open-ended, nondeterministic, and teleonomic (rather than narrowly teleologic).

Origins cycle through evolutionary phylogenies at the junctures of new sign types, and through developmental ontogenies at the junctures of new sign tokens. Seeking origins in either type of self-organization process entails probing time. Sometimes our inquiries become nonsensical, when the question of “what/how/why before” comes down to “before before”. Time itself collapses, as does space, when we push through the edges of our epistemological system.

At the present, semioticians (e.g., Merrell 1994a, b; Gould 1994) tend to insert analogue continua between all conventional digital nodes in

time as well as in space and in substance. In part, this might be a reaction to the overdose of digitalities, dichotomies, and classifications generally during the long reign of structuralistic, semiological praxis. While continua may refresh us, and open up those mysterious gaps left unexplored in an earlier semiotic, the present trend may itself become overdetermined and sterile. For one thing, one can not ask questions of origins at all within the emerging paradigm.

4. Signs as futures

Signs reveal as well as conceal the ripples from their kinky, convoluted past, where structures and functions, patterns and relationships, flip-flop with mutation-like abandon (Bohm 1980; Koch 1991). Signs also invite – without determining – their own futures. They spill toward fulfillment, but remain perpetually incomplete, cycling in a dynamic and thereby life-like, execution-driven movement. One could also map this sinuous flow onto Peircean categories, as Nathan Houser (1991) and Floyd Merrell (1991a, 1991b, 1994a, 1994b) among others, already have done with respect to Peirce's ten species of sign.

Because signs flow, by necessity and by accident, they incessantly become themselves (developmentally) and sporadically become other signs (evolutionarily). In so doing, they generate by-products which themselves, indeterminately, contribute to the overall shape of the process. Of course, to say "by-products" may mislead, for it draws our awareness back dangerously close to "products" and to "function". In this just-so linear rationalization of "by-products" and "products" we err in privileging an exclusively developmental mode of thinking, which in larger doses leads to bald teleology.

Indeed, friction and waste are also by-products or unintended consequences of semiotic processes involving, as they do, information and energy. While "by-product" suggests an unintentionality potentially redeemable by *positively* recoverable (or tamed) outcomes, "waste" carries an overwhelmingly *negative* connotation. "Noise" likewise suggests a friction-like drag on the parent system, interfering with its own integrity. Here I wish to neutralize to some degree these connotations. Under certain very normal conditions entailing open, irreversible, nondeterministic systems, "waste" and "noise" can transcend chaos and erupt into order (Prigogine 1984), rendering an instance of "origin".

The metaphor of "waste" to describe the inevitable by-productions of unbridled semiotic flows may still require some laundering before we

can use it non- or pre-judgmentally. One potential in the semantic field of “waste” lies in its liminality to the figured system. First of all, “waste” may be on its way into or out of consciousness, out of or into nothingness. Secondly, “waste” may reinforce the figured system or may bootstrap itself from the ground to the figure itself. These behaviors suggest the movement of a system – including either the marked figure or both the figure and its ground – into transition states having unequivocal genealogical connections with antecedent states.

Aside from these integral roles for “waste”, and regardless of its degree of liminality or degree of circumscription within the system, “waste” may provide the pivot swinging the system with (or without) waste, or the waste itself, into a transformed orbit which can only be described as evolutionary. It is the evolutionary which generates surprise, and more unequivocal origins. But once set into flow, into respiration, the sign proceeds to develop, precipitating suspense, eventually to spin into originary eddies again.

Semiotic systems appear both profligate and stingy. In their flow of habitual breathing, they hurtle toward new developmental stages and fresh evolutionary states, each opening up generous genres of “origin”. At the same time, in the same breath, as it were, semiotic systems succumb to rationalization measures whereby some processes are economized and others eliminated and still others utterly redefined. These are parsimonious genres of “origin”, with even the semiotic systems selected out (given dysfunction or by accident) leaving residues for fresh invention.

A favorite image suggesting infinite and incessant continuity-cum-change, transition-cum-transformation, has been the Möbius strip. In such a contorted but still linear universe, the only origin would be hopping onto the strip. I have noted that some semioticians appear to be pushing continuity to its limits as an antidote to the structural slavery to paradigms, taxonomies, typologies, keys, lists, and other dimensional systems of classification.

The intuitive appeal of creation and dissolution, origin and collapse, growth and decay, cannot be sated by a compulsively analogue semiotic, however. Even though each phenomenon can be wrung of digitality, and of difference, by the imposition of interpolation, we are also deprived of any cultural and linguistic and cognitive discontinuities, including origins. A somatic trope such as breathing and a visual image such as an hourglass may prove instructive. Both privilege time, and as such both will be friendly to contemporary moves toward continuity.

Breathing, as has been pointed out, represents all the pervasive diphasic processes in the universe – rhythms with phases of rest and activity, for instance. Is the originary breath inhaling fuels or exhaling wastes, or perhaps their monolithic unity? There are moments of juncture when the system is neither at rest nor in action, or/and both at rest and in action, just as in a stream of vocal sounds in language, each phoneme bleeds into the following one even as it anticipates that following sound.

The being of breathing merges with the becoming of breathing, at the “now” of the waist of the hourglass. Any real hourglass hangs in developmental space, with an evidently finite amount of sand above the waist and an evidently finite space for collection of time-processed sand beneath it. Clearly, the actual hourglass is a human tool-toy provisioned by the human hand and human mind, and fashioned by a human creator, and more subject to entropy than negentropy. Nonetheless, on pondering the hourglass as a catalyst for understanding, we fixate on the behavior of time, not of sand or of hands or of humans. Thus integrating time and the provisional, provisioning extrinsic elements means that the sand above and below the waist/waste of “now” will be infinite, not finite, rendering the hourglass into a vitally *open* model.

Our mind’s eye might sketch in a myriad of Möbius strips connecting the grains of sand with futures, hanging above, with the grains of sand with pasts, deposited below. The futures have evolutionary potentials to precipitate into circumscribed developmental pasts. Each grain and each movement possesses a tangle of antecedents and relationships and origins, and an even messier tangle of futures. The Möbius strips become more unruly as they come to resemble the double helixes of DNA, with the complication that the bonding sites can swivel in all directions and not just link one pair of spirals. Synchronic, structural models of the micro-organic appear like spaghetti finger-painting, and our model must acknowledge both time and explicit nonlinearities. The Möbius strips/multiple helixes bifurcate and coalesce with abandon, with different perspectives affording different views to an observer – each perspective facilitating *and* obstructing some useful, some useless, *and* some misleading illusions.

On closer monitoring, the entropic exhale of the dropping grains becomes syncopated, regularly irregular, irregularly regular – more than suspenseful and sometimes surprising, not unlike heartbeats. Many grains and momenta will be negentropically scooped up as the system inhales, creating fresh semiosic watersheds, bringing new futures, new origins, new pasts, new nows, into view.

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Semiotic principles and systems: Biological foundations of semiotics

Udo L. Figge

1. Introduction

Semiotic behavior of animals (including humans) cannot be explained on the basis of only one semiotic principle, e.g., the principle of communicative needs. On the contrary, it is important to distinguish two semiotic principles: one principle which underlies receptive semiotic behavior and deals with the further processing of information extracted from sensory input, and a second principle which underlies productive semiotic behavior, using some existing effector organ to express inner states that would otherwise remain imperceptible.

Semiotic behavior is based on semiotic systems. A semiotic system establishes relationships between certain inner states of an organism that normally are inaccessible and imperceptible from outside and its periphery, making those states accessible according to the first semiotic principle or perceptible according to the second principle. A partial semiotic system realizes either the first or the second semiotic principle. A complete semiotic system is a combined realization of both principles in one and the same individual.

2. Semiotic principles

The world is made up of matter and energy. Consequently, an organism can only exchange matter and energy with its environment. Matter taken in by organisms is, for the most part, directly transmitted in the process of metabolism. Energy, however, can be assimilated only in plants and photobacteria by means of photosynthesis. In animals, energy coming from outside either fades away (e.g., energy transmitted by a blow) or stimulates organs sensitive to energy, i.e., sense organs, thus generating *information*. In animals, information can thus result from a specific processing of energy. There are, however, also sense organs that transform matter into information, namely, the chemical senses. All such

information, whether going back to energy or to matter, contributes to the concept an organism forms of its environment.

Now, it can happen that an organism does not use newly acquired information as such, directly adding a new element to its representation of the world, but rather goes on processing it. This kind of further processing results in a state inside the organism that is quite dissimilar from the original information. Thus, a bee stimulated by energy to form the percept of a certain color may transform this percept into the concept of nectar. As nectar is almost colorless, this concept has nothing to do with the original color percept (which goes back to petals). This example illustrates the following first semiotic principle:

First semiotic principle: The subsequent processing of energy or matter by an organism results in a particular inner state.

“Subsequent processing” of this sort is something like a diversion of the usual flow. That is why I like to call it “oblique”.

One of the effects of metabolism is the excretion of matter. Moreover, metabolism enables organisms to expend energy so that they can act upon their environment. Now, certain inner states of organisms which, in principle, are not perceptible to their environment are coupled with peripheral organs in a way that certain forms of expending energy or excreting matter function as manifestations of these inner states. A typical example of such an inner state is mating motivation. It is a genuine inner state, insofar as it normally passes unnoticed by the environment. Animals, however, have learned to use various peripheral organs in order to manifest mating motivation, e.g., glands produce smelling substances (matter) or vibrating organs produce sound waves (energy). These are examples of the following second semiotic principle:

Second semiotic principle: Effector organs are used to manifest inner states that are otherwise imperceptible.

“Manifesting” in this context means “making perceptible in an indirect manner”.

The first semiotic principle already proves advantageous whenever obliquely triggered inner states allow a better adaptation of an organism’s behavior to its environment. It makes possible an oblique gain in environmental information leading to an enrichment of the organism’s conception of the world. Thus, bees must have improved in foraging behavior since the moment they became enabled, by the first semiotic principle, to transform obliquely a color percept into the representation of a nearby nectar source. However, this principle assumes a new

quality, as it were, when the energy or the matter taken in by an organism is emitted by another organism of the same species according to the second semiotic principle. In this case, the organism has the possibility of arranging its interaction with organisms of its own species in such a way that its fitness will increase. This is clearly the case when the inner state triggered off obliquely is a motivation to mate with an individual of the same species which has manifested its readiness to mate.

3. Semiotic systems

An organic system is separated from its environment by its outer integument. Nevertheless, there are influences which the system exerts on its environment and which the environment exerts on the system. Accordingly, the system can assume states that are almost autonomous with regard to the environment as well as states due to environmental influences or aiming at an effect on the environment. An example of an autonomous state is the hormone level of an organism. Hormones have to do with the self-regulation of the organism. An effect of the environment on an organism can be the perception that an enemy is approaching. Such a perception can call forth a defensive reaction, e.g., the secretion of poison. The states underlying perception and secretion are examples of states an organic system can assume in connection with interactions between the system itself and its environment. Now, there are certain inner states which are autonomous with regard to the environment, but whose interaction with the environment would be advantageous to the organism if such interaction were possible. It is from such inner states that the *development of semiotic systems* (semiogenesis) originates.

A prominent example of such an inner state is mating motivation. Without doubt, it would be to the advantage of an organism if its mating motivation led to copulation immediately. In order to copulate, however, an individual needs a partner. Now, if partners are not at hand at the right time or are at hand, but not in a mating mood, copulation becomes impossible, and the mating motivation fades away without any effect. This produces a dilemma: an inner state that should have an immediate effect on the environment runs the risk of remaining autonomous because the effect is not attainable. Of course, there are direct solutions to this problem. Many species live in narrow territorial communities (at least temporarily, for instance sea lions). In certain species of insects,

rudimentation of wings guarantees a strong limitation of mobility in the individuals of one or the other sex. In a certain deep-sea anglerfish and in a certain species of worms (*Bonellia*), evolution went still further: the males are extremely stunted and live fixed on the females (Vogel – Angermann 1984: 169). A common solution to the dilemma, however, is a semiotic one. By producing a signal on its surface, the organism makes the autonomous state perceptible in an indirect manner, according to the second semiotic principle, and thus deautonomizes it. This is always done by means of the usual processes of influencing the environment, i.e., by expending energy or by excreting matter.

In the case of bisexual reproduction, there must be another organism able to take in and then process this energy or matter in such a way that it also achieves mating motivation. Ultimately, the manifestation of an autonomous inner state can only be advantageous if there are other organisms processing the corresponding perceptions according to the first semiotic principle, i.e., processing them obliquely, as signals, and thus achieving the corresponding inner state.

The production and the reception of mating signals are an example of what I call a semiotic system. In general, a *semiotic system* is always a component of an organic system. Its central function is to establish specific relationships between the inside of this organic system and its periphery. As mentioned above, a semiotic system presupposes that inside the total system there are inner states that can neither be perceived nor manipulated from outside although the perceptibility or manipulability of these states would be advantageous to the total system. Furthermore, it presupposes that the total system has exits and/or entrances at its surface. The exits are mostly peripheral organs that can be moved somehow. The entrances are always organs of perception.¹ There are, in principle, two kinds of processes a semiotic system enables an organic system to execute:

- (1) a specific processing of perceptions and an eventual subsequent modification of inner states,
- (2) the manifestation of inner states that are not perceptible to the environment by means of peripheral organs.

A perception can be processed either directly or obliquely, i.e., according to the first semiotic principle. Only in this second case is it processed as a signal. The manifestation of an inner state always results in the production of a signal, according to the second semiotic principle.

4. Kinds of semiotic systems

Semiotic systems can be divided into complete and partial ones. For a biological species, being endowed with a *complete* semiotic system means that each of its normal adult individuals is enabled both to manifest certain inner states by producing certain signals and to perceive, and obliquely process, such signals in a way that may result in the modification of the corresponding inner states. A *partial* semiotic system enables an individual either to produce or to perceive and obliquely process certain signals, but not both. Receptive partial semiotic systems can be differentiated according to the source of the signals. Signals can originate from individuals of the receiver's own species or from some other source in its environment.

An example of a partial semiotic system with signals having their origin in the environment is the capability of the honeybee to extract oblique knowledge about the position of a nectar source from the perception of the shape, the color, and the smell of flowers. Most systems connected with mating motivation as an inner state are examples of partial semiotic systems with intraspecific signal flow. They are partial systems insofar as the individuals of one sex are only able to produce these signals, whereas individuals of the other sex are only able to perceive and process them. An example of a complete semiotic system is, of course, human language. Nevertheless, with a view to making some remarks about the evolution of complete semiotic systems in general, I will now give a sketch of two other such systems.

One of these systems has been observed in certain species of collective amoebae (cf. Shimomura et al. 1982, Bonner 1983, Vogel – Angermann 1984: 184-185). These amoebae are primitive protozoan unicellular organisms whose life cycle includes two very different phases, an individual and a collective one. During their individual phase, they feed on other unicellular organisms, namely on bacteria. When a feeding place is grazed out, they aggregate into a multicellular slime mold with spores containing single amoebae. These spores can be spread by insects or by water, burst at a warm moist place and then set free their passengers. This is the beginning of another individual phase. Now, just before the collective phase sets in, several physiological processes occur in the individual amoebae. On the one hand, these processes result in the synthesis and the excretion of different substances, especially a pheromone called acrasin. On the other hand, they bring about the insertion of protein molecules in the outer cell membrane, which function as chemoreceptors. The collective phase begins with a rhythmical

excretion of acrasin as a manifestation of an inner state that can be characterized as a kind of aggregation motivation. The absorption of acrasin by other individuals triggers off a similar inner state. Of course, one could ask whether the production and reception of a certain substance forms only a relatively simple causal chain without any semiotic characteristics. The system, however, presents a notable peculiarity. Although the chemical processes that constitute it are clearly cellular-metabolic processes, they do not contribute to the maintenance of cellular functions. On the contrary, the formation of a slime mold is tantamount to the death of a part of the population. The creation of the physiological bases of the processes and the processes themselves clearly serve to manifest and to trigger a kind of motivation. Thus, they must be considered as components of a semiotic system.

The other complete semiotic system is the wagging dance of the honeybee (cf. Lindauer 1961, Frisch 1965, Figge 1986). Normally, a bee performs a wagging dance inside the hive on the vertical surface of a comb when it comes back from a successful flight to a nectar source. Essentially, these dances are characterized by three different kinds of variations:

- (1) variations in the number of wagging runs per unit of time in connection with variations in the speed of the dance,
- (2) variations in the angle between the direction of the wagging run and a vertical line,
- (3) variations in the vivacity and the absolute duration of the dance.

These variations result from

- (1) variations in the energy consumed by the bee in its flight to the nectar source, mostly in covering the distance, sometimes also in surmounting head wind or differences in altitude,
- (2) variations in the direction of the nectar source (the line between the hive and the source, possible roundabouts due to obstacles being neglected),
- (3) variations in the quality of the nectar sources.

The following relationships have been observed between these two sets of variations:

- (1) The more energy the bee has been forced to spend on its flight, the more slowly it dances, and, consequently, the less wagging runs it executes per unit of time. Thus, under normal wind and terrain conditions, ten wagging runs per 15 seconds correspond to a flight of

100 meters, six runs to 500 meters, four runs to 1,000 meters, and one run to 10 kilometers, which is the maximum. When the distance is less than 100 meters the bee performs its dance without wagging.

- (2) When the nectar source from which the bee comes is situated exactly in the direction of the current position of the sun (its azimuth), the wagging run is oriented vertically upwards, in a direction opposite to gravity. When the position of the source and the position of the sun form, e.g., an angle of 15° to the right or to the left, the wagging line inclines by 15° to the right or to the left. Thus, a positive heliotaxis is rendered by a negative geotaxis.
- (3) The more persistently and vehemently the bee dances, the higher it estimates the quality of the nectar source.

Through their dance movements, bees manifest knowledge about the distance, the direction, and the quality of nectar sources (or other places vitally important to them). The wagging runs of these dances are accompanied by noises which the bees produce, most probably by means of rhythmical innervations of their flight musculature (Michelsen et al. 1986). The other bees perceive these manifestations partly acoustically and partly by means of tactile perception, following the dancer and touching it with their antennae. An oblique processing of these perceptions allows them to form knowledge very similar to that of the dancer.

5. Evolution of semiotic systems

In an evolutionary perspective, the productive component of the chemical semiotic system of the collective amoebae can be regarded as a by-product of normal cellular metabolism. The excretion of chemical substances is a common cellular process, especially in “stress” situations, such as those caused by scarcity of food. In one of the many species of slime molds, *Polysphondylium violaceum*, the acrasin is a peptide called “glorin” by its discoverers. Peptides are substances which originate from the decomposition of protein compounds and which are therefore found in every cell. In species of the genus *Dictyostelium* the acrasin is cyclical adenosin monophosphate (cAMP), which plays a central part in cellular processes. In particular, it is synthesized in great quantities during a certain phase of cell division (Vogel – Angermann 1984: 39) and, in particular, it contributes to the differentiation of cells during the formation of a slime mold. As to the receptive component, it is by no means uncommon for protein molecules to develop on the

surface of the cell membrane and for some of them to function as receptors for chemical substances. Nor is it uncommon for cells to react chemotactically to such substances. Thus, it can be concluded that this component originally evolved as a partial semiotic system allowing to process obliquely substances taken in and by that means making chemotaxis possible. This means that the two components of the system did not co-evolve as such. Rather, they evolved separately, the first one as a by-product of metabolism and the second one as a partial chemotactic system. Their meeting was due to an evolutionary accident that came about the moment the substances taken in by the chemotactic system happened to be those given out by individuals of the same species. Only then did the excretion of acrasin turn into the manifestation of an inner state, namely, aggregative motivation, according to the second semiotic principle.

In discussing the phylogeny of the honeybee dance, Frisch (1965: 323-330) argues that its elements can be traced back to nonsemiotic movements. Normally, such a dance is performed between the return from a successful flight and the start for another flight. This suggests indeed that the discharge of emotions and of surplus energy and intentional movements should be regarded as precursors to the elements of the honeybee dance. Thus, the productive component of the system can be considered a by-product of other activities.

Now, in order to turn movements into the indication of a direction, a distance, and a quality, the bee did not have to change its behavior at all. Instead, it had to make other bees understand its wagging runs as such an indication. Recruiting works only if the recruits are aware that they are to be recruited. Since, however, it is difficult to imagine how a bee could have achieved something like that, I think it more plausible to assume that the bee dance as a semiotic system originated with the followers rather than the dancers themselves. In this interpretation, the nonsemiotic precursor is the attention most animals pay to the behavior of their conspecifics, and bees, too, are attentive animals. Under certain circumstances, it can be advantageous for an individual to guess the actual causes that are behind the emotions and motivations of other individuals. In the case of the bees, guessing from where the dancer comes and where it goes helps the follower to avoid an expensive search on its own account. So it is most probable that the bee dance as a semiotic phenomenon originated, according to the first semiotic principle, as the capacity to process certain perceptions obliquely. The semiotization of the dance itself can be explained as a process of underscoring movements in order to make them more clearly perceptible

or, in more technical terms, as a ritualization of these movements. Ritualization is a way of following the second semiotic principle, using emphatic movements for producing signals and, by that means, manifesting inner states.

In many respects, the semiotic system of the collective amoebae and that of the honeybee are quite different from each other. Above all, they differ in their sensory modalities (chemical vs. tactile-acoustic) and in the inner states they are connected with (motivation vs. knowledge). Therefore, it is completely out of the question that there could be any evolutionary relationship between the two. They are not homologous. They can, however, be considered *analogous* because they are governed by the same semiotic principles.

There is still another common feature. In both cases, the receptive and the productive component *evolved independently* of one another and were then *joined by an evolutionary accident*. In the amoebae as well as in the bees, the development of the receptive component came about as an effect of the first semiotic principle. The individuals became enabled to process certain perceptions obliquely and, as a result, to adapt certain previously unadaptable inner states to states of their environment. In the case of the amoebae, these inner states were probably motivations to reach certain places (chemotaxis). In the case of the bees, it was more than that, namely, a kind of knowledge about the position of such places. In the amoebae as well as in the bees, the productive component was initially nothing but a capacity to exert an influence on the environment in a way that corresponded by chance to the evolving receptive component (excretion of chemical substances and performance of movements). Later on, this capacity was used, according to the second semiotic principle, to manifest inner states that corresponded to the states connected with the receptive component. Thus, these components did not co-evolve in the strict sense of the word. Rather, they evolved towards the same point (pace Lindauer 1990: 247-248). Though their meeting at this point was not inevitable, it was not an extremely improbable event. The reason is that in a given species, the number of classes of inner states, the number of effectory modalities, and the number of sensory modalities are relatively small, so that there is a good chance that a combination of a certain kind of inner state and a certain effectory modality will correspond to a combination of the same kind of inner state and an equivalent sensory modality, if such combinations evolve.

6. Conclusions

The following conclusions can be drawn from the foregoing evolutionary reflections on the two complete semiotic systems sketched above.

- (1) The different semiotic systems observed in the animal kingdom are normally analogous rather than homologous insofar as they realize the same semiotic principles.
- (2) The first semiotic principle - a sort of looking behind perception - is self-sufficient. Receptive semiotic systems can exist without a productive counterpart. Moreover, such systems already develop as semiotic systems. Productive semiotic systems, by contrast, develop as by-products² of nonsemiotic processes or activities, as epiphenomena of nonsemiotic phenomena. In order to achieve semiotic status, according to the second semiotic principle, they must combine with a receptive system. A prerequisite of such a combination is that the sensory modality of the receptive system matches the effectory modality of the productive system and that both systems are connected with the same class of inner states. These conditions are not difficult to fulfill, since in a given species, the number of effector modalities, the number of sensory modalities, and the number of classes of inner states are normally relatively limited. Thus, although the meeting of a receptive and a productive system is always due to an evolutionary accident, it is never a highly improbable event.
- (3) Often, the combination of a receptive and a productive semiotic system results in the pairing of two partial semiotic systems, as in the case of most sexual signaling systems, which are semiotically dimorphic. However, it can develop into a complete semiotic system, enabling all normal adult individuals of the species to show both productive and receptive semiotic behavior, as in the case of the honeybee dance or of human language.

Communicative needs are often regarded as a uniform principle underlying semiotic behavior.³ However, as argued above, such a uniform principle does not exist. Communication, especially in the sense of intentional interaction, results from the combination of two systems that are realizations of two clearly distinct semiotic principles.

Notes

1. Semiotic systems can also be components of technical systems, especially of computers. In this case, the exits and the entrances respectively are output and input devices (cf. Figge 1991).
2. For the concept of by-product, cf. Lindauer 1990: 248-252.
3. Sebeok (1967: 88), for instance, defines the field of zoosemiotics as "the ways whereby animals communicate with each other" and then writes about one of its branches: "The basic assumption of zoosemantics is that, in the last analysis, all animals are social beings, each species with a characteristic set of communication problems to solve" (1967: 93).

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Opposition at the roots of semiosis

Winfried Nöth

γίνεσθαι τε πάντα
κατ' ἐναντιότητα

*All things come into being
by conflict of opposites.*
Heraclitus¹

The universality of opposition in semiosis has been an essential tenet of the major doctrines of semiotics. Opposition, moreover, seems to be constitutive not only of semiosis, but also of the structure of the presemiotic micro- and macrocosm. The classics of semiotics have mainly argued from a synchronic point of view when investigating opposition as a prerequisite of structure and system in semiosis. The present paper extends this argument from the synchronic domain to the origins and evolution of semiosis.

1. Roots of semiosis: From difference to opposition

Opposition has been a key concept in structuralist semiotics. The term is closely related to the notion of *difference*. Often, both concepts are not clearly differentiated or even used synonymously, but usually, *difference* is the more general concept which comprises *opposition* as a more specific subcategory. The concept of *difference* became established as a key term of semiotics by Saussure, whereas the distinction between difference and opposition has its semiotic foundation in the writings of Jakobson.

1.1 Paradigmatic difference, otherness, and signs

According to Saussure (1916), difference is the source of semiotic structure. The value of any semiotic element can only be discerned with reference to all other structures of the system from which the given element differs. This idea is expressed in Saussure's *principle of differentiation*. It states that "in language, as in any semiological system, whatever distinguishes one sign from the others constitutes it. Difference makes character just as it makes value and the unit" (Saussure 1916: 121). According to this principle, semiotic elements can only be defined negatively. Nothing in semiosis exists positively without reference to otherness. This is the essence of Saussure's (1916: 120) dictum that "in

language there are only differences *without positive terms*" and that "everything in language is negative".

The principle of differentiation holds both for the expression and the content planes of a semiotic system. As to the phonetic expression plane of language expression, Saussure (1916: 118) argues: "The important thing in the word is not the sound alone but the phonic differences that make it possible to distinguish this word from all others, for differences carry signification." With respect to the content plane, Saussure (1916: 117) gives this definition of meaning in terms of difference: "Concepts are purely differential and defined not by their positive content but negatively by their relations with the other terms of the system. Their most precise characteristic is in being what the others are not."

Thus, a given phoneme acquires its semiotic value by its difference to all other phonemes of the system, and a concept derives its meaning only from its difference from all other concepts. Difference, in this interpretation, is thus a dyadic relation between a given term and all other elements of the same semiotic plane. In other words, Saussurean difference is a paradigmatic relation between a semiotic element and the other members of the paradigm to which it belongs. Saussure (1916: 118) expresses this idea of difference as paradigmatic otherness by saying "that a segment of language can never in the final analysis be based on anything except its noncoincidence with the rest". The logical nature of this dyadic relation of otherness is the one of a contradictory opposition (p vs. not- p).

1.2 Syntagmatic difference as a source of cognition

Parallel to Saussure's thesis of difference as the source of semiosis, cognitive science and information theory have developed the theory that difference is the source of cognition and information. A main proponent of this theory, Gregory Bateson (1979: 29, 98-99), more recently followed by Merrell (1992: 207) states:

Perception operates only upon difference. All receipt of information is necessarily the receipt of news of *difference*, and all perception of difference is limited by threshold. Differences that are too slight or too slowly presented are not perceivable. They are no food for perception ... Precisely because the mind can receive news only of difference, there is a difficulty in discriminating between a *slow change* and a *state*. There is necessarily a threshold of gradient below which gradient cannot be perceived . . . *Information* consists of differences that make a difference.

According to this definition, perceptual differences arise as cognitive figures of otherness against a ground of unperceived samenesses. Differences presuppose a change against the background of static sameness. Mere sameness without difference remains unperceived, but so does mere difference without sameness, which is perceived as chaos. In this definition, difference is also a dyadic relation, but not one of a paradigmatic kind. The terms of this dyad, sameness vs. otherness, constitute the syntagmatic relation between a ground and a figure.

Within the framework of semiotics, Greimas (1966: 19) defines difference as the cognitive root of semiosis when he writes in his *Structural Semantics*: "When we perceive differences, the world 'takes form' in front of us and for us." While, according to Bateson, difference is the root of information, Greimas and Courtés (1979: 79) define it as "the first condition for the appearance of meaning". In this interpretation, difference is also a dyadic structure whose terms are otherness and sameness (Greimas and Courtés 1979: 79): "A difference can only be recognized over against a supporting background of resemblance. Thus, it is by postulating that difference and resemblance are relations . . . which can be gathered together and formulated into a specific category, *alterity/identity*, that one can construct the elementary structure of signification."

1.3 Opposition as a dyadic structure

The concept of opposition is sometimes defined in the Saussurean sense of difference as paradigmatic otherness (cf. 1.1). In the tradition of Prague School phonology, e.g., a given phoneme is in "opposition" to all other phonemes which create a difference of meaning in the same phonological context. For example, the phoneme /k/ is in opposition to /f/, /p/, /r/, /t/, and /w/ in the context of /-u:l/ since these phonemes differentiate the meanings of *cool*, *fool*, *pool*, *rule*, *tool*, and *wool*. Jakobson (1962: 301-303, 421), however, rejects this usage of the term opposition and calls such relations "mere differences". In contrast to the general concept of difference, which relates a given term to an open class of other terms, the more specific concept of opposition in Jakobson's interpretation relates a given term only to a single other term. In this interpretation, opposition is synonymous with *binary opposition* (cf. Holenstein 1976: 121-137; Waugh 1976: 65).

Terms in binary opposition, according to Jakobson (1962: 637), are more closely related than dyads of terms forming a mere "contingent duality". Like the idea of 'whiteness' evoking the one of 'blackness' and

the idea of 'beauty' evoking the one of 'ugliness', "the presence of one term in a binary opposition necessarily implies and educes the other, opposite term" (Jakobson 1962: 637). Therefore, "the phoneme by itself is not a term of opposition. E.g., the phoneme /b/ does not call univocally, reversibly, and necessarily for a definite opposite" (Jakobson 1962: 421). Not the phonemes, but only their distinctive features, such as '+/-voiced' or '+/-nasal' are terms of opposition according to this definition.

The plus/minus pattern of oppositional structure, however, does not only represent dyads of mutually exclusive alternatives. Jakobson (1962: 273) admits two types of oppositions, opposition between contradictory and opposition between contrary terms. Dichotomies of the exclusive yes/no or either/or kind represent contradictory oppositions, while polar extremes at the end points of a graded continuum, such as between 'white' and 'black' represent contrary opposition. Further below (cf. 4.0), we will refer to these two types of opposition as digital vs. graded opposition (see also Nöth 1994a).

In the sense of a dyadic structure, the term opposition has meanwhile become generally accepted in the field of structural semantics. Thus, Lyons (1977: 270ff.), while further extending the traditional classification into contraries and contradictories, distinguishes four major types of semantic "opposites", antonymy (*happy/sad*), complementarity (*male/female*), converseness (*parent/child*), and directional opposition (*up/down*). Lyons differentiates between oppositions as binary contrasts of meaning and other semantic relations which he calls nonbinary contrasts.²

1.4 Opposites as elements of semiotic systems

The "necessary and reciprocal implication", which Jakobson postulates for the two terms forming an opposition, can only come about by the mediation of a third term, a *tertium*, specifying the kind of relation by which the terms of the dyad are more closely associated than terms of a mere contingent duality. This relation is one of sameness³ or "equivalence in difference" (Jakobson 1971: 262). In the light of this third term specifying the sameness in difference, the oppositional dyad turns out to be a triadic relation.⁴ Let us designate henceforth the three terms involved in an opposition as *primum* and *secundum*, with reference to the dyad, and *tertium*, with reference to the term of equivalence. The question whether the *tertium* really comes third, as the logical term *tertium comparationis* suggests, or whether it is perhaps a *primum*,

from which it derived by a *principium* (a “first”) *divisionis* (cf. Jakobson 1962: 634), will have to be investigated below (2.).

The integration of oppositional dyads into semiotic triads is the process which leads from semiotic elements to semiotic systems. Oppositions are thus the building blocks of semiotic systems (cf. Ivanov 1973, 1983). In the field of semantics, e.g., Greimas (1966) has devised the model of a “semantic universe” whose elementary structures are binary opposites (*prima* and *secunda*) integrated via their *tertia* into the hierarchy of a semantic system. Figure 1 represents a segment of this universe, the semic system of ‘spatiality’. In Greimas’s interpretation, the dyads of elementary structures of signification are characterized by relations of *disjunction*, specifying the differences between the *semes*, and of *conjunction*, specifying their *tertium* of semantic sameness.

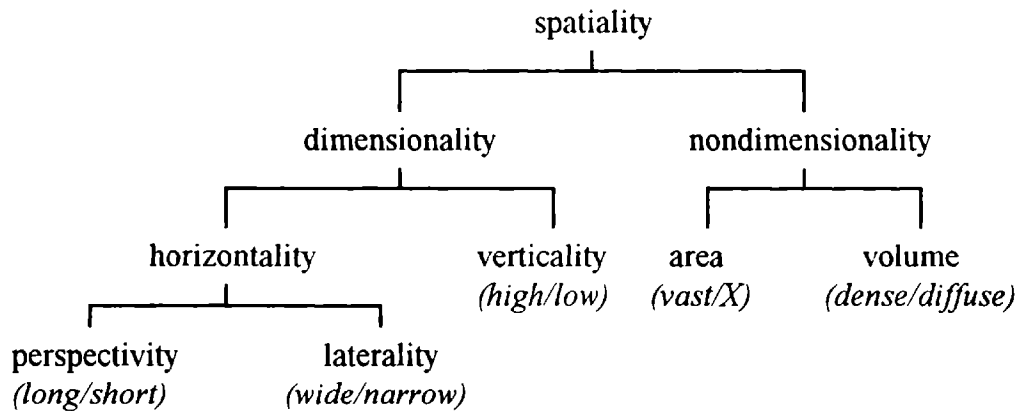


Figure 1. Greimas’s (1966: 33) semantic universe of ‘spatiality’ exemplifying the integration of *prima* and *secunda* into *tertia*.

Whereas semiotics in the tradition of Jakobson considers oppositions and their integration into *tertia* as the source of semiotic systems, the integration of dyads into triads is a more fundamental root of semiosis in the semiotic philosophy of C.S. Peirce. Semiosis, according to Peirce (CP 6.32), is a process of *mediation*, “whereby a first and a second are brought into relation” by means of a third. Mere difference defined as otherness would not qualify for semiosis. Since “*other* is merely a synonym of . . . *second*” (CP 6.213), difference can only relate a first to a second.⁵ “A sign”, by contrast, “is a sort of a Third” (Peirce 1977: 31). A dyad without the mediation of a third is only a presemiotic “individual fact, as . . . it has no generality in it” (CP 1.328).⁶

1.5 Antisymmetry in opposition

In spite of their equivalence vis à vis their tertium, the oppositional dyads of semiotic systems are typically not symmetrical, i.e., of equal value within the system. The difference between the dyadic terms is also a difference of value. This kind of dyadic nonequality against a background of sameness corresponds to the geometrical pattern of antisymmetry, i.e., a symmetry of constituents which are equal in one respect, but different in another (cf. Ivanov 1974; Nöth 1994b). In phonology, semantics, and grammar, antisymmetry has been investigated as the opposition between the marked and the unmarked term of oppositions (cf. Waugh 1976: 89-102). Compared to the unmarked pole, the marked member of an opposition has an additional value. It is structurally more complex, provides more specific information, occupies a subsequent position in serial order, is learned later by children and lost earlier by aphasics. This antisymmetry between the dominant and the subordinate, the focused and the unfocused, or the positive and the negative is so deeply rooted in the evolution of culture that Derrida (1977: 236) even ascribes a metaphysical dimension to the idea of the priority of the unmarked, giving the following two indicators to bear witness to this argument:

1. The hierarchical axiology, the ethical-ontological distinctions which do not merely set up value-oppositions clustered around an ideal and unfindable limit, but moreover *subordinate* these values to each other (normal/abnormal, standard/parasite, fulfilled/void, serious/non-serious, literal/non-literal, briefly: positive/negative and ideal/non-ideal); and in this . . . , there is metaphysical pathos . . .
2. The enterprise of returning "strategically", ideally, to an origin or to a "priority" held to be simple, intact, normal, pure, standard, self-identical, in order *then* to think in terms of derivation, complication, deterioration, accident, etc. All metaphysicians, from Plato to Rousseau, Descartes to Husserl, have proceeded in this way, conceiving good to be before evil, the positive before the negative, the pure before the impure, the simple before the complex, the essential before the accidental, the imitated before the imitation, etc. And this is not just *one* metaphysical gesture among others, it is *the* metaphysical exigency, that which has been the most constant, most profound and most potent.